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ABSTRACT

The Concept Attainment Model is described as a teaching approach that helps students develop skills for inductive and deductive thinking while learning subject matter in any field in a constructive and meaningful way. A definition and overview of the model are presented, with guidelines for using the concept-attainment approach to design and deliver instruction and to evaluate student learning of subject matter and thinking skills. The model is an instructional approach in which teachers guide students to derive an abstract, generic idea inductively using pattern recognition and categorizing skills, and then help them deductively apply the concept in new situations. The theory of concepts of Jerome Bruner is the source of the model, which was transformed into a teaching model by B. Joyce and M. Weil (1972, 1980, 1986). Planning for teaching with the concept attainment model involves: (1) identifying a significant and definable concept; (2) analyzing its essential and defining features; and (3) designing exemplars from which the concept can be derived. The model offers teachers a method for teaching thinking across the curriculum using the subject matter of disciplines they teach. Five figures illustrate the discussion. (Contains 10 references.) (SLD)

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Teaching Thinking Across the Curriculum with the Concept Attainment Model

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Teaching Thinking Across the Curriculum
with the Concept Attainment Model

Introduction:

All students develop thinking strategies, but most do not independently learn a comprehensive array of critical-thinking skills. Further, most students are not consciously aware of the thinking skills they do possess or of how they employ them. Because of this, a great many of our students will not become consciously powerful thinkers unless we provide them with careful and long-term instruction in systematic critical thinking.

Contemporary definitions of critical thinking center on the theme of *constructive intellectual activity*--activity that is purposeful, uses reasoning and criteria, takes place in a context and is self-directed. Ennis (1989), for example, defines critical thinking as "reasonable reflective thinking focused on what to believe or do." Oxman and Weinstein (1993) state that ". . . critical thinking constitutes the willingness to identify and apply the set of principles that support judgement through the best available reasons." Lipman (1988) asserts that "Critical thinking is skillful, responsible thinking that facilitates good judgement because (1) it relies upon criteria, (2) is self-correcting, (3) is sensitive to context. Paul (1993) says of critical thinking that it is "the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, or evaluating information gathered from, or generated by observation, experience, reflection, reasoning, or communication, as a guide to belief and action." Further, Paul explains, critical thinking takes place "within some domain of knowledge or human concern."

These definitions acknowledge that critical thinking is a complex and extremely comprehensive activity. They describe it as a constellation of intellectual behaviors and imply that critical thinking takes time to develop. They make clear that critical thinking requires the continual processing and integration of information, ideas, principles, and judgement within a framework of reason. Unquestionably, to become competent in this kind of constructive intellectual activity, students need instruction.

There is broad agreement among leaders in the field of critical thinking (Ennis,1989; McPeck, 1990; Norris, 1992; Paul, 1993; Stearns, 1992; Sternberg, 1985) that we can best help students develop critical-thinking skills by teaching these skills across the curriculum, within the various subject areas. As a group, these theorists offer three reasons for their position. First, because thinking does not occur in isolation and must have an object--something to think about--it is efficient for students to learn to think by thinking about subject area content. Second, since

in addition to content, each subject area or discipline comprises ways of thinking about the world, it is meaningful for students to learn the subject areas as thinkers. Third, because ways of thinking in one subject area are often analogous to or in the "same family" as ways of thinking in other subject areas, students can learn skills in one area that while relating to that area, can also be related to other areas and can be generalized to life experience.

There is, then, a convincing case for teaching critical thinking across the curriculum. The challenge lies, however, in developing integrated, practical models for doing this. It is one thing to commit to teaching thinking across the curriculum, but to so consistently and comprehensively in social studies, grammar or physics, is another. To simultaneously teach subject matter and critical-thinking skills in a reliable and effective way requires a paradigm or model--a way of teaching--that will engage students in learning content and process. In essence, such a model must meet the following criteria:

- ***The model must help teachers teach important aspects of the subject area.*** Teachers must be able to identify and teach knowledge that will help students deal with the subject area itself, that can be related to other subject areas and that can be applied to their life experiences beyond the classroom.

- ***The model must help teachers address pivotal critical-thinking skills.*** Teachers must be able to teach thinking skills that apply in the subject area and--either directly or through translation--in other areas and/or in their life experiences.

- ***The model must help teachers engage students in assessing their own learning and thinking.*** Teachers must be able to make students aware of the critical-thinking skills they use to develop intellectual products and of how they can improve and the use of these skills and of the material they learn.

Purpose of the Paper:

The purpose of this paper is to describe the Concept Attainment Model, which is a teaching approach that helps students develop skills for inductive and deductive thinking while at the same time learning subject matter in any field, in a constructive and meaningful way. The paper presents a definition and overview of the model, examples of teachers working with it, and guidelines for using the concept-attainment approach to design and deliver instruction and to evaluate students' learning of subject matter and of critical-thinking skills.

Definition of the Concept Attainment Model

The Concept Attainment Model is an instructional approach in which teachers guide students to inductively derive an abstract, generic idea--a concept--using pattern recognition and categorizing skills and then help them deductively apply the concept in new situations. Students derive the concept by analyzing teacher-presented items which do and do not reflect it, and from this develop an hypothesis of what the concept must be. They then test, refine and confirm their concept hypotheses by applying them to additional, teacher-presented items in which the concept is and is not present. Finally, students demonstrate concept attainment by constructing their own positive exemplars of the concept and by explaining the thinking steps they used to attain it. As students progress through the model, they engage in a cycle of inductive and deductive thinking and strengthen the particular critical-thinking skills which comprise these two forms of reasoning.

Development of the Model

Jerome Bruner's, ***A Study of Thinking*** (Bruner, Goodnow and Austin 1967) is the source of the Concept Attainment Model. In this book, Bruner presents his findings about human use of pattern recognition and categorizing to develop concepts with which to think. Bruner's theory of concepts can be summarized in the following way. Humans scan items of information they receive to find patterns of similarity. They then cluster items that share similar features in categories and label these categories with names. Each category, its name, its constituent items and the shared features of those items are a **concept**, a cognitive structure that helps human beings hold information in an abstract form and use it to think with. As humans continue to encounter and scan information items, they can add those with appropriate features to existing categories, or they can create new categories for items that have new, shared features. Through this pattern recognition and categorizing process, human beings build up many concepts for use in thought and communicating with others.

Bruner's theory of concepts has been transformed into a teaching model by Bruce Joyce and Marsha Weil in their book, ***Models of Teaching*** (1972, 1980, 1986). Joyce and Weil create a "syntax" or description of how to put Bruner's theory of concepts into action in the classroom. This syntax consists of three phases through which teacher and students move. On the basis of extensive field work helping teachers to use the Concept Attainment Model, the present author has adapted the Joyce and Weil syntax so that it consists of four phases. That adaptation of the model is presented in Figure 1.

Figure 1. Syntax for the Concept-Attainment Teaching Method
(Adapted from Joyce and Weil)

Phase I	
Teacher	Students
• Invites students to derive a concept and presents items labeled as positive and negative exemplars.	• Compare features of positive and negative exemplars. • Develop and test hypotheses of the concept and its essential features, (critical attributes).
Phase II	
Teacher	Students
• Presents additional unlabeled, positive and negative exemplars.	• Test concept hypotheses with new, unlabeled exemplars. • Modify and refine concept hypotheses as necessary.
Phase III	
Teacher	Students
• Elicits and confirms students' hypotheses. • Provides concept name if necessary.	• Generate/find own concept examples. • State concept by name and in terms of critical attributes.
Phase IV	
Teacher	Students
• Guides students' analysis of thinking strategies they used.	• Explain ways attributes were found. • Describe attribute cues and integration in hypotheses. • Discuss range of hypotheses generated.

Teachers and students work cooperatively through four phases to use the Concept Attainment Model.

As Figure 1 shows, the Concept Attainment Model makes it possible to teach students significant content in a subject area while at the same time teaching them the specific thinking skills of observing, analyzing, hypothesizing and hypothesis testing, and engaging them in metacognition. The model begins with the requirement for inductive thinking as students reason from particular exemplars to the general concept. As they begin to attain the concept they test

their understanding by testing the concept deductively, using their general hypothesis of the concept to determine which of a new set of exemplars do and do not "belong" to it. At its conclusion, the model helps students become consciously aware of the thinking skills they used and how they integrated these to derive the concept of interest.

Figure 1 also indicates that the implementation of the Concept Attainment Model presents teachers with very real challenges. To bring the model to its full potential, teachers need to select significant and appropriate concepts; develop positive and negative exemplars for them; guide students through careful observation, analysis and work with hypotheses; create activities in which students can apply the concepts they learn; and find ways to help students think about their thinking. In other words, use of the Concept Attainment Model requires comprehensive and systematic *planning* and thoughtful and focused *teaching*.

Planning for Teaching with the Concept Attainment Model

To design a concept-attainment instructional sequence for use in a particular subject area, teachers carry out three steps:

- **Identifying a significant and definable concept in the area,**
- **Analyzing the concept's essential and defining features,**
- **Designing exemplars from which the concept can be derived.**

By carrying out these steps, teachers strengthen their own understanding of the concept, its *critical attributes* and the way it manifests itself. They also develop a flow of thinking experiences which will help their students grasp the concept and recognize how they did this. The following provides a detailed description of each of these steps.

1. Identifying Significant and Definable Concepts

Concepts that are both significant and definable are those that help students gain important footholds in a subject area and that can be discretely defined in terms of critical attributes which students can understand. For example, in elementary social studies, the concept of "community helpers" is an important one for second graders to attain and it is clearly bounded in that children of this age can recognize the critical attributes that define a person as a community helper. Similarly, in middle school science, students need to learn the fundamental concept of "life." They can do this with concept attainment because "life" is a concept definable in terms that middle-school students can understand.

As a result of their education and experience in their subject areas, teachers can often spontaneously identify and list the core concepts their students need to learn. Or, they can "map" the subject area they teach in a more formal way, laying out a semantic diagram of the subject area which states the primary outcome, students should gain from learning the area and the topics/concepts they need to understand in order to achieve that outcome. If, however, teachers are working in fields in which they have less education and experience, they can also turn to text-book tables of contents and curriculum guides to find subject-area outlines of significant concepts. Whichever approach is used, teachers are potentially able and qualified to identify the concepts that are important for their students to understand and that can be defined in terms students can comprehend.

2. Analyzing Concepts' Critical Attributes

It is the critical attributes of a concept that make it possible for people to understand it and communicate about it with one another. Because a concept is an abstraction of objects, experiences or ideas that have shared critical attributes, people can attain a concept--abstract it--by examining instances that reflect its attributes. This abstracting process, as explained earlier, is the basis of concept-attainment instruction. When they use this model, teachers present examples and non-examples of the concept and guide students in discriminating the critical attributes contained in the positive exemplars and missing from the negative ones. Students then coalesce these attributes into an hypothesis of the concept. For this to occur successfully in the classroom, teachers, themselves, must analyze each concept they intend to teach and must discriminate the critical attributes of each. The format depicted in Figure 2 provides a helpful mechanism for doing this. The figure shows how a fifth-grade social studies teacher analyzes the concept of states' population-based representation in the Federal Government.

Figure 2. Analysis of a Fifth-Grade Social Studies Concept

Concept:	States' Population-based Representation in the Federal Government
Rule:	States elect the members of the U.S. House of Representatives on the basis of state population as determined by the Federal census.
Critical Attributes:	
	a. Federal census apportions number of representatives per state. b. Representatives are elected to membership in the House of Representatives.

Teachers systematically describe in writing the concepts they intend to teach.

To use the format in Figure 2, the teacher first identifies the concept by name. In this case, the concept is a key topic in the study of U.S. Government, one that students need to understand as part of that study, and one that will be vital to them when they become adult, politically-participating citizens. The teacher begins using the topic itself as the concept name, then states the concept as a rule. This rule is an operational statement and explains the mental and/or physical actions that bring the concept into existence. The teacher also specifies the critical attributes of the concept, again the mental and physical actions necessary to concept presence, but this time stated individually in list form.

Teachers can carry out concept-analysis steps in any order, identifying the concept name, rule or critical attributes first, second or last. As they work to develop and integrate these three components, they typically find that they need to think back and forth several times among them, checking one against another until they arrive at a succinct concept name, a complete rule statement and all critical attributes of the concept presented individually in a list. Teachers also find it helpful to "try out" their concept names, rules and critical attributes with colleagues who teach in the same subject area and in this way, make sure that they have a comprehensive guide for designing the positive and negative exemplars that students will use to derive the concept.

3. Designing Positive and Negative Exemplars of Concepts

To design positive and negative exemplars of a concept, teachers envision real-world scenarios in which the concept is active. Then they briefly describe these scenarios as exemplars in one or more complete sentences. There are four reasons for this sentence-scenario guideline. First, exemplars expressed as complete scenarios give intellectual dimension to the concept. This is more likely to engage students in searching for and finding critical attributes in a deliberately conscious way, rather than in an intuitive and less articulate fashion. Second, sentence-scenario exemplars help students actually envision the concept at work on the stage of their minds. This is particularly helpful for visual learners. Third, sentence-scenario exemplars present students with opportunities to systematically use and strengthen critical reading skills as they seek to abstract the evident critical attributes of a concept. Fourth, these exemplars can serve as guides for students' own construction of exemplars and for their expository writing in general.

Figure 3 presents an instructional plan designed by an eight-grade physical science teacher. The plan includes a set of sentence-scenario exemplars divided into two subsets for use in the first and second phases of the model. The plan also includes the teacher's complete analysis of the concept of interest--measurement--so that the presence of the concept's critical attributes in the positive exemplars can be determined.

Figure 3. Plan for Teaching Eighth-Graders the Concept of Measurement for Use in Physical Science

Concept: Measurement

Rule: Measurement is the act of using a measuring instrument to numerically describe the characteristics of physical phenomenon in terms of recognized and accepted standard units.

Critical Attributes:

a. uses measuring instrument
b. describes numerically
c. uses standard units
d. describes physical phenomenon

Exemplars for Deriving the Concept:

1+ Celeste sells blue crabs to restaurants on the East Coast. She grades them as medium, large and jumbo using a gap gauge that ranges from 5 to seven inches.

2+ Paulo wants to gain weight for wrestling. He is using exercise and a high-protein diet and recording his weight weekly as it is shown on the training-room scale.

3- Jim went deep sea fishing for half a day last Saturday. He caught 2 yellow-fin tuna and rated the experience as a "10."

4- In the regional figure skating trials, Nadia's did very well in "creativity." She received scores of 6.2, 6.0 ,6.4, 6.5, and 6.1 from the judges.

5+ Tony is training for a 50K bicycle race. Each day he rides a 75K course and times himself with a chronometer to determine his improvement.

6- The baseball coach emphasized that he uses focus and dedication as the most important criteria in his selection of first string players.

Figure 3. (Continued)

Exemplars for Testing and Confirming the Concept Hypothesis:

7. Sara raises rare ferns in her small greenhouse. She has attached an alarm to the thermometer to signal if the temperature changes more than 5 degrees. (+)

8. Chen was surprised to learn that it is possible to use a volt meter to prove that some kinds of fish generate 100 or more volts of electric current. (+)

9. Student research project proposals will be evaluated on a 10-point scale and those that receive 7 or above have a good chance of receiving some funding. (-)

10. LaDon and Celia conducted a survey to find out how strongly the school's math teachers believe in giving assignments every day. (-)

11. Ty Ling demonstrated how to use a sextant to determine the elevation in degrees of a known star, and then how to use that to determine boat position. (+)

12. When she used the school telescope, Debra was able to discriminate 3 moons of Jupiter and to see 2 different shades in the rings of Saturn. (-)

Teachers craft positive and negative exemplars to help students derive and confirm concepts.

Figure 3 shows that in planning a concept-attainment lesson, teachers develop two sets of positive and negative exemplars to help students derive the concept, then test and confirm it. The first set will be presented to students with labels so that they will have identifiable examples of the concept and can analyze these for its critical attributes. The second set will be presented without labels, and students will be asked to assign positive and negative labels to them on the basis of the concept they have hypothesized using the first set.

The figure also shows that the teacher has made sure that positive exemplars reflect all four critical attributes of the measurement concept. The negative exemplars do in almost every case contain some numerical information and this can be a red herring for students in that numerical information is also a critical attribute of the positive exemplars of measurement. Close comparison of the two kinds of exemplars, however, reveals that the negative ones do not describe the use of a measuring instrument to record physical phenomenon in standard units.

Finally, the figure shows that the negative exemplars *are not* scenarios of people measuring incorrectly. Rather, non-examples show people engaged in *something other than* measurement--in rating subjective experiences and in counting. The point here is that in the

Concept Attainment Model, exemplars teach a concept by having students compare scenarios that depict valid, concept-reflecting activity (positive exemplars) with scenarios that reflect valid activity that is, however, not reflective of the concept of interest. Negative exemplars *are not incorrect examples.*

In conclusion, Figures 1 through 3 reveal that planning a concept-attainment, instructional sequence takes time. It involves teachers in holistically thinking through the subject matter they teach, in doing research that may be necessary to develop clear and specified descriptions of the concepts they intend that students learn, and crafting creative and life-based positive and negative exemplars of these concepts. To accomplish these tasks, it is helpful for teachers to have guidelines. Figure 4 summarizes the basic guidelines for carrying out this planning in an efficient and effective way.

Figure 4. Guidelines for Planning Concept Attainment Instruction

1. **Identify significant and definable concepts for teaching in a subject area.**
2. **Specify selected concepts in terms of name, operational rule and critical attributes.**
3. **Design exemplars that accurately reflect and do not reflect the concepts for students' use in deriving and confirming the concept.**

Following these guidelines helps teachers focus concept-attainment instructional planning.

Using the Concept Attainment Model in the Classroom

The framework of the Concept Attainment Model requires that teachers integrate elements of control and elements of flexibility in their teaching behavior as they implement the model. Additionally, to implement the model in its most powerful form, teachers need to help students apply the concepts and thinking skills they learn beyond the lesson itself. Perhaps the best way to see how these two kinds of elements imbue the model is to look at a complete instructional sequence. The following sequence designed by an eleventh-grade English teacher includes the teacher's plan for the lesson and demonstrates how the teacher adapts the concept-attainment approach to the needs and abilities of her students.

An Instructional Sequence for Using the Concept Attainment Model to Teach Eleventh Graders the Concept of the Cumulative Sentence

Concept: The Cumulative Sentence

Rule: A sentence that consists of an independent clause followed by one or more absolute or participial phrases that add concrete detail about information presented in the opening clause.

Critical Attributes:

a. a sentence
b. structured as independent clause followed by absolute or participial phrase(s)
c. independent clause makes a general statement
d. following phrases add concrete details for the statement

1. Miss Bryan's eleventh-grade English students are writing short stories as fantasy or science fiction. She wants them to understand cumulative sentences as a writing tool and says:

"Your excellent plot outlines and cast-of-character sheets tell me you're ready to begin writing your stories. We'll have a writing workshop period on Friday. Before that, I want to show you a special, sentence tool you can use to make your writing rich in description and vibrant with action."

"I have six sentences that could be found in short stories. Three are marked with plus signs. These are the kind of sentences I want you to begin using in your writing. Three marked with minus signs are not that kind of sentence. We'll look at all of them, one by one. Then you'll compare the two types, come up with a definition of the special sentence and a description of its structure."

She displays the sentences one by one, identifying each as either an example or non-example.

1+ The boulder plummeted down the mountainside, a relentless force smashing small trees in its path, a roaring brute surging mindlessly down.

2+ Several deer stood by the stream, brown eyes gazing intently at us, nostrils twitching in gentle rhythm.

3- The crowd cheered the clowns and laughed, but a girl in a straw hat and blue checked dress nervously watched the people passing.

4- The neighborhood was run down, yet the house, with its wide, unpainted porch and crazily curtained windows was somehow cheerful.

5+ The skater accelerated, blades whispering across the ice, hair streaming in the wind, scarf flying behind him.

6- The green, metal-flake sport car raced faster and faster around the track, and each up-shift of its gears was noisier than the last.

2. Students begin to work, but evidence frustration. "These sentences are all alike to me!" says Tricia, in an irritated tone. "They all describe places and actions."

   "Yes." agrees Ms. Bryan. "But the plus-marked sentences have several things in common that the minus-marked sentences don't have. To see those differences, look closely at the opening idea in each kind of sentence, then ask yourself what the following ideas in each sentence do for its opening idea. Let's do the first and third together."

   "The first sentence opens with the idea that **a boulder fell**. What do the ideas about **a relentless force** and **a roaring brute** do for the opening idea?"

   "They add to it, tell how the boulder fell." says Merrill.

3. "Right." nods Ms. Bryan. Now look at the third sentence and determine the relationship between its opening and following ideas. It talks about **a crowd cheering and laughing**, then about **a girl watching people**. What does the second idea do for the first?"

   "Nothing really," Jeralyn says hesitantly. "I mean they are like--balanced against each other. The crowd is doing one thing and the girl something else. It's all part of the same story, but still, two different things happening."

4. "That's a major key, Jeralyn--and all of you." says Ms. Bryan. The following ideas in the plus-marked sentences add detail to their opening ideas. In the minus-marked sentences that is not so. Now, look again and see if you can find anything else that separates the pluses from the minuses."

   She circulates and finds that several students who understand grammar are differentiating the cumulative sentences on the basis of their independent clause + participial phrase structure. Several others are noticing the absence of connectives in the cumulative sentences. She decides to strengthen students' various understandings by showing them a second, unlabeled set of exemplars.

7. Why was she silently laughing, hands covering her mouth, shoulders shaking with mirth? (+)

8. How do bulbs "know" when it is time to sprout, and how do they know it is safe for them to put forth flowers? (-)

9. Can you picture the sea in summer, long rollers creaming in to the beach, gulls wheeling and screaming overhead, tiny crabs clambering over rolling pebbles as the waves recede and recede? (+)

10 The phone rang, an urgent trill cutting through the night, a thin, bubbling voice terrifying us all. (+)

11. Women and children went first, voices calling out to each other, eyes rolling with alarm, fingers grasping the ladder rungs in panic. (+)

12. What kind of person will make a good president, and what standards will the public use to judge that person during and after the presidential campaign? (-)

5. "There are several questions in this set." Ms. Bryan points out. "But the kind of sentence we are seeking is still here. Which should be marked with a plus, and which with a minus?"

   Students label all the sentences correctly.

6. Now we need to define our special sentence and describe its structure. To do that let me tell you its name. It is called a *cumulative sentence*. Why is that?"

   "Because it adds details to an opening idea! It *accumulates* information about the opening idea." exclaims Tricia. "The others don't. Their ideas are details of some *other* idea *not* the opening idea."

7. "Yes!" Ms. Bryan responds. "What other special characteristics of this cumulative sentence did you find in the positive examples?

   "Well," suggests Josh, "The ideas that follow the opening ones in the cumulative sentences are just rammed up against the opening ideas. They aren't connected with **and, but, yet**--words like that."

   "Another thing," adds Jeralyn, "The cumulative sentence is made of an independent clause followed by phrases. The other sentences are made of two or more independent clauses."

8. Ms. Bryan sums up: "Putting this all together gives us a complete definition of the cumulative sentence. Please copy and complete this definition frame."

   > The cumulative sentence opens with a (general idea) followed by (specific ideas) that add concrete details to the (general idea). The opening idea is in an (independent) clause and the following ideas are in (phrases).

9 "How did you pull the concept of the cumulative sentence out of these examples?" asks Mrs. Bryan.

   "You made us think about how the ideas in both kinds of sentences relate to each other. This helped us start to see the differences." says Merrill.

   "Also, we looked at the way the sentences are constructed and found more characteristics of the ones that had add-on idea relationships. You had to get us started, though."

10. "Yes, that was a problem." agrees Ms. Bryan. "Why couldn't you get started with this concept on your own?"

    "Because we didn't know *how* to look at the sentences. We didn't think about idea relationships in them, or their structure--not until you helped us. We kept looking at the sentences as all the same somehow. But next time, I think we could find other special kinds of sentences on our own--by looking at the way they relate ideas *and* at their structure." concludes Jeralyn.

The teacher in this sequence knows that good writing requires work. To write well in any form requires the deliberate and careful arrangement of words, phrases and clauses in ways that convey the meaning the writer intends. She knows that to move from writing as primarily a spontaneous and intuitive activity to writing as art and craft, her students must have various kinds of sentence tools. She wants to teach them the cumulative sentence as one of these, but knows that a good many of them have no reliable sense of formal grammar. Thus, she must teach the sentence first from the perspective of the way it conveys meaning, then, for those students who can deal with grammar, from the perspective of its grammatical structure. She believes that her eleventh graders can apprehend the cumulative sentence from one of the two perspectives and carefully constructs exemplars that will work with both kinds of students. In this way, she maintains control of the concept-attainment approach while at the same time responding flexibly to her students' learning situations.

To make sure that students have a solid base from which to derive the concept of the cumulative sentence, the teacher begins the lesson by explaining the steps in the concept-attainment approach. (Step 1) Then she presents students with two positive exemplars followed by a negative exemplar in the form of a very different kind of sentence. Immediately, however, students are unable to compare and analyze the exemplars. (Step 2) The teacher recognizes that this is because they have never considered that there may be a connection between the meaning of a sentence and the way it is constructed. When they hit a blank wall and say that all the exemplars are the same, she does not, however, abandon the model and tell students why the exemplars are different. Rather, she helps them while at the same time maintaining control of the model. She guides them to look at the way the phrases in the cumulative sentence add details to the clauses in those sentences, then to compare this relationship to that of the two independent clauses in the negative-exemplar sentences. (Steps 2, 3 and 4).

When students understand how the cumulative sentence relates its ideas to each other, the teacher shows them additional positive and negative exemplars which are more difficult because they contain questions. (Step 4) She holds students to a high level of thinking performance, however and expects them to use the hypotheses she has helped them develop with this second exemplar set. (Steps 5 and 6) She pushes them even further to identify other attributes of the cumulative sentence and encourages students who understand grammar to contribute key features from that perspective. (Step 7) As the lesson concludes, the teacher continues to maintain control of the model by requiring students to state the concept rule and critical attributes (Step 8) and by helping them to assess both their thinking and what they have learned. (Steps 9 and 10) Students see that while they did not initially have a sentence-analysis strategy, they now have one in meaning/structure and can use this to identify new kinds of sentences in the future.

This teacher's expectation that students will use the cumulative sentence in their own stories helps them apply both the concept itself and thinking skills they learned in their own lives. To use the cumulative sentence will require them to think very thoroughly about what descriptive detail they want to use to elaborate the main clause statements they make. They will have to mentally observe and analyze the scenes and situations they depict in those main clauses, then select appropriate detail to use. This observation and analysis will involve them in coming to grips intellectually with what it is they are trying to say in their writing--what images they want to evoke in their readers' minds and what ideas they want their readers to understand. Thus, their efforts to use the cumulative sentence will engage them in thinking critically about their own writing and in making it significantly more vivid. Further, as students think about and use cumulative sentences, they are likely to become more observant of and analytical about the sentences other writers use. This may increase their understanding of ways types of sentences function as stylistic devices for creating mood and tone in a piece.

In the long run, by requiring students to systematically develop the concept of the cumulative sentence, the teacher provides them with a tool which they can use flexibly to convey their own ideas in particular ways. The controlled use of concept attainment here also presents them with an initial piece of evidence about the craft of writing. This concept-attainment lesson (and similar ones that the teacher is likely to use) demonstrates the over-arching principle that writing is a deliberate, thought-through activity in which writers shape what they mean through the sentences they elect to use.

The cumulative-sentence instructional sequence demonstrates that teaching with the Concept Attainment Model calls upon teachers to use a specific syntax in a fairly controlled fashion while at the same time adjusting each phase in the syntax to the needs and abilities of students. Additionally, it calls upon teachers to develop opportunities for students to use the content knowledge and thinking skills they learn in ways that empower them in situations that are meaningful to them. Again, as teachers prepare to implement their concept-attainment lessons with students, guidelines for their teaching behavior are helpful. Figure 5 summarizes guidelines that can help teachers implement the Concept Attainment Model in their classrooms.

Figure 5. Guidelines for Teaching with the Concept Attainment Model

1. **Teach students how to use the concept-attainment approach.**
2. **Establish a pattern for student recognition of the concept by beginning with two positive exemplars followed by a negative exemplar.**
3. **Help students to use observation and analysis to compare the two types of exemplars.**
4. **Increase the difficulty of exemplars in later phases of instruction.**
5. **Require students to state the concept rule in writing in terms of its critical attributes.**
6. **Help students assess the thinking they used and learning they accomplished.**
7. **Provide students opportunities to apply the knowledge and thinking skills they develop.**

Summary and Conclusions

The Concept Attainment Model offers teachers a method for teaching thinking across the curriculum using the subject matter of the disciplines in which they teach. It is a model which helps teachers broaden their own, holistic understanding of their disciplines as ways of thinking about the world, and helps them consider which concepts in the discipline students most need to understand in order to use the knowledge and skills the discipline encompasses. The model strengthens teachers' own subject-area knowledge and critical-thinking skills by engaging them in analysis and specification of the concepts they wish to teach. It also affords them opportunities to create realistic exemplars that reflect the concept and in doing so, helps them understand the thinking process students need to use as in order to derive the concept. Finally, it provides teachers with opportunities to help students apply the concepts and critical-thinking skills they learn in the classroom and beyond.

Commitment to use of the Concept Attainment Model or any discipline-based approach to teaching critical thinking has several important implications for teachers. Many teachers have not had experience with holistically mapping their own disciplines. While they possess an intuitive understanding of what the subject area they teach comprises, they have not brought this to the level of consciousness necessary for identifying core concepts students must learn and for determining how these core concepts empower students both within the discipline and in their life experiences. Insofar as teachers can be helped to develop these comprehensive views of their disciplines, their abilities to design and deliver instruction under the aegis of any model will

be strengthened. Providing teachers with the skills to map their own disciplines is a first responsibility of teacher-education programs in colleges and universities and where time and financial resources permit, in school-system staff-development programs.

Commitment to use of the Concept Attainment Model specifically, requires teachers to understand the theory and nature of concepts. They must develop acute skills of observation and analysis in order to determine the critical attributes of the concepts they expect students to learn and they must develop an in-depth understanding of how concepts in a discipline are actually reflected in the life experiences of their students. They must be able to envision scenarios in which these concepts are reflected and must be able to write clear and accurate descriptions of these concepts. It is likely that teachers can only develop these skills as a result of reflecting on the interaction between their own general education in universities and colleges and their teacher-education experiences in learning theory and human development. In the experience of this author, this reflection seems to take place most naturally and effectively for teachers as they pursue post-graduate work in education after they have taught for two or three years.

To teach with the concept-attainment approach requires that teachers be willing and able to engage with their students in intellectual discourse. This in turn requires the ability to create classroom environments that are not centered on behavior control, but in which teachers can demand and expect intellectual rigor of students. Such environments cannot be suddenly created but must be nurtured over time. It is likely that insofar as teaching begins at the earliest possible moment with a focus on thinking--on helping students make a habit of addressing meaningful concepts, observing closely, expressing themselves clearly and accurately, using evidence, reasoning and self-evaluation--the classroom environments necessary to using concept attainment and other thinking models will emerge naturally. As these learning environments flourish and grow, teachers and students alike will find great satisfaction in using the Concept Attainment Model to affirm the intimate interrelation between knowing and thinking.

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